stands before so humiliating an exhibition of groundling bigotry as is presented by some of the religious sects of the present day" (p. 472).

In striking contrast to this is the conclusion reached by Mr. Phillips in his volume. In fact, the whole of it seems to be written for the purpose of proving the opposite opinion. He asserts that the farther back we go in the Vedic age, the purer and higher do we find the conceptions of divinity, man, duty, worship, a future state, sacrifice, etc. Hence he avers: "The development of religious thought in India has been uniformly downward—not upward—deterioration and not evolution." He explains this by the theory of a 'primitive divine revelation' granted to the Aryan forefathers, darkened and lost in their descendants. He shows a good reading knowledge of the Vedas in his discussions, but a total ignorance of the methods which now obtain among real scholars in treating the historical growth of religious phenomena. The need of such a work as that of Prof. Hopkins and of the series which it commences, is amply indicated by the appearance of such an essay as that of Mr. Phillips.

D. G. Brinton.

SCIENTIFIC JOURNALS.

THE AMERICAN JOURNAL OF SCIENCE.

The February number of the American Journal of Science opens with an article by A. M. Mayer, giving the results of an extended series of experiments upon the modulus of elasticity of bars of various metals and its variation with change of temperature. This modulus was obtained by transverse vibrations of bars of known dimensions and density. Rods of steel, aluminum, brass, glass and American white pine were employed. These were vibrated longitudinally, held between the thumb and forefinger, and the vibration-frequencies determined by the help of the standard forks of Dr. Koenig's tonometer in Paris. The application of Poisson's formula (shown to hold closely true by special experiments) gave the velocity of sound, and the modulus of elasticity was then calculated from the usual mathematical relation connecting these quantities. Special experiments were employed to give the coefficients of expansion, the densities, etc. The results are contained in an extended table and further represented graphically in a series of plates. These show that the decrease of the modulus of elasticity of glass, aluminum and brass is proportional to the increase of temperature; straight lines referred to coördinates giving the results of experiments on these substances. The five steels, silver and zinc give curves, convex upwards, showing that the modulus decreases more rapidly than the increment of temperature; while bell metal alone gives a curve which is concave upwards; its modulus decreasing less than the increment of temperature. Bell metal was found to be an alloy peculiarly well suited for bells, as the intensity and duration of its vibration were the same at 50° as at 0°; all other substances showing a marked diminution of intensity and duration of sound at 50°.

In a special discussion as to the acoustical properties of aluminum, it is shown that this metal is not peculiarly *sonorous* as ordinarily believed. On the contrary, if a bar of aluminum and a bar of brass having the same length and breadth and giving the same note are struck transversely so that the bars have the same amplitude of vibration, the bars give equal intensity of sounds; but the bar of aluminum from its low density and because of its internal friction will vibrate less than one-third as long as the bar of brass. The peculiarity of aluminum consists in this fact, that its unusually low density (2·7), combined with a modulus of elasticity of only 712×10^6, renders this metal easy to set in vibration; a transverse blow given to a bar of this metal causes it to vibrate with an amplitude of vibration greater than that which the same energy of blow would have given to a similar bar of steel or of brass.

It is true, however, that since aluminum gives, from a comparatively slight blow, a great initial vibration, and since its vibrations last for a short time, this metal is peculiarly well suited for the construction of those musical instruments formed of bars which are sounded by percussion and the duration of whose sounds is not desirable.

On the other hand, there is one serious objection to the use of aluminum in the construction of musical and acoustical instruments, and that

is the great effect that the change of temperature has upon its elasticity. If a bar of aluminum and a bar of cast steel be tuned at a certain temperature to exact unison, a change from that temperature will affect the frequency of vibration of the aluminum bar 2½ times as much as the same change of temperature will affect the bar of cast steel.

A second physical article by Carl Barus gives the results of experiments carried on, with the aid of a fund from the Smithsonian Institution, on the curl aneroid. The special object of the investigation was to find what degree of constancy and precision could be obtained from a suitably modified Bourdon tube, or flattened tube coiled in the form of a helix. A similar tube had been used before successfully for high pressures with, however, certain limitations which do not exist in the case of low pressures, for which it is now designed, *e. g.*, when exhausted for use as an aneroid in registering small changes of atmospheric pressure. Experiments with simple curls are detailed, made very thin by dissolving away the walls in acid. Also other experiments with a counter-twisted system; that is, one supplied with a coiled spring placed above and opposed to the flattened and exhausted curl. The results of the experiments with this form show that by it the hurtful effects of viscosity and changes of temperature can be reduced to a minimum, while the sensitiveness of the instrument is increased to a remarkable degree. G. W. Littlehales discusses from a mathematical standpoint the problem of finding an isolated shoal in the open sea which had been located by previous observation. He concludes that, under certain conditions named, there would be one chance in 6,173 of finding it. This explains why navigators often fail to find shoals shown on their charts. H. B. Kümmel gives a note on the glaciation of Pocono Knob (Monroe county) and Mounts Ararat and Sugar Loaf (Wayne county), in Pennsylvania, which have hitherto been regarded as having risen above the ice during glacial times. The author's observations, however, lead him to conclude that the ice probably covered the highest points of all these summits. T. L. Walker gives the result of a study of crystals of the platinum arsenide, sperrylite, from Algoma, Ontario. He also adds some notes as to its occurrence, and notes the presence of iridium and osmium in the matte from the Murray mines, leading to the conclusion that these metals are sometimes constituents of the sperrylite. S. L. Penfield and E. H. Forbes describe the results of an investigation of the optical properties of the members of the chrysolite group of minerals as connected with their chemical composition. It is shown that the mean index of refraction, and also the strength of the double refraction, diminish with decrease in percentage of iron protoxide, FeO; on the other hand, the value of the optic axial angle (2V) increases. With the FeO about 12 per cent., 2V for yellow equals nearly 90°. Chrysolites containing less than 12 per cent. FeO have the crystallographic axis *a* for the acute bisectrix and are optically positive with dispersion $\rho < v$, and those richer in iron are optically negative with dispersion $\rho > v$.

The concluding twenty-five pages of the number are occupied with abstracts of papers in other journals, notices of books, scientific news, etc.

ASTROPHYSICAL JOURNAL, JANUARY.

Action of the Editorial Board of the Astrophysical Journal with Regard to Standards in Astrophysics and Spectroscopy.

The board of editors, who have had the question under consideration for the past year, have adopted for the magazine the following standards:

The *Rowland scale of wave-lengths*, the unit of wave-length to be Ångström's, the ten millionth of a millimeter, known also as the 'tenth-meter.'

The *kilometer* as the unit of measurements of motion in the line of sight.

The hydrogen lines to be designated Hα, Hβ, etc., beginning at the red end and continuing through the entire series. Maps of spectra will be printed with the red end on the right, and tables of wave-lengths with the shorter wave-lengths at the top.

The hope is expressed that the action of the editors will be concurred in by other astronomers and physicists, and adopted in their publications.

On the Spectrum of Clèveite Gas: C. Runge and F. Paschen.

The complete results of the writers' investigations are now published for the first time. Tables of wave-lengths and of double lines are given in full. When separated into six series, the lines show a striking regularity. Apparently there are two pairs of these series, each pair approaching a limit common to its components. From this and other reasons it is concluded that the gas consists of two elements, for the lighter of which the name Parhelium has been adopted. The hypothesis of two constituents is strengthened by the fact that vacuum tubes can be made which show the helium series much less brightly without a corresponding decrease of intensity in the parhelium series. Moreover, in the spectrum of the sun's limb the stronger of the helium lines are, according to Young, always seen, those of parhelium only about once in four times.

On the Gases obtained from Uraninite: J. Norman Lockyer.

A paper read before the Royal Society containing some notes on the new gases recently obtained. These notes consist largely of comparisons of the spectra of these gases with those of the Sun and stars.

Outline of an Electrical Theory of Comets' Tails: Reginald A. Fessenden.

The writer advances the theory that a comet's tail consists of negatively charged carbon particles driven from the nucleus by the action of the ultra-violet light of the Sun, its shape being the resultant of four forces: Gravitation acting towards the Sun, electric repulsion of the negative charge on the Sun, attraction due to the positive charge on the comet's nucleus, electrostatic repulsion existing between each negatively charged particle. The varied cometary phenomena are then examined in the light of this theory.

Photographic and Visual Observations of Holmes' Comet: E. E. Barnard.

This is a résumé of observations made in 1892–93. The frontispiece is an enlargement of a photograph of the comet made soon after its discovery.

The Modern Spectroscope, XV.: F. L. O. Wadsworth.

In this number of the series is suggested a form of mounting for the concave grating that will overcome its astigmatism so disadvantageous to certain forms of astrophysical work.

Minor Contributions and Notes.

Recent Researches Bearing on the Determination of Wave-lengths in the Infra-red Spectrum: James E. Keeler.

Harvard College Observatory, Circular No. 3: Edward C. Pickering.

THE PHYSICAL REVIEW, VOL. III., NO. 4., JANUARY–FEBRUARY, 1896.

On the Photometry of Differently Colored Lights, and the 'Flicker Photometer:' By F. B. Whitman. Based upon the peculiar effect of a flickering light upon the eye (discovered by Prof. Rood), Prof. Whitman has devised a new form of photometer for comparing the luminosities of colored lights and pigments. The construction of the instrument is briefly as follows: The colored surface to be studied is mounted obliquely upon a photometer carriage, and is illuminated from a source of light at one end of the bar. On the same carriage is mounted a white disk receiving light from the other end of the bar, and so arranged that it can be rapidly rotated. This disk is given such a shape that it hides the colored surface during half of each revolution. The eye of the observer thus receives light alternately from the colored surface and the rotating disk, and at low speeds there is a disagreeable flickering sensation. At high speeds the flickering is no longer noticed; strangely enough the sensation of color practically disappears at the same time, so that it is sometimes found impossible to tell what color is being experimented with. When the speed is sufficiently great the instrument can thus be used as an ordinary photometer, and makes possible a comparison of luminosities without annoyance from color differences.

Prof. Whitman describes a number of experiments which were made in order to test the instrument, and finds it much more reliable than the ordinary types of photometers.

The Chemical Potential of the Metals: By W. D. Bancroft. This paper is devoted especially

to a discussion of the experimental data which have a bearing upon Nernst's theory of the E. M. F. of a voltaic cell. Dr. Bancroft is inclined to look upon certain aspects of this theory with considerable distrust. His conclusions may be summed up as follows:

1. The potential difference between a metal and an electrolyte is not a function of the concentration of the salt solution, nor of the nature of the positive ion, except in certain special cases.

2. It is a function of the electrode, of the negative ion, and of the solvent.

3. In aqueous solutions the potential difference is the sum of the term due to the electrode and the term due to the negative ion in the normal cases.

4. For most metals in most electrolytes the term due to the negative ion has the same numerical value and the same sign.

The tables accompanying this article, in which are collected the results of some ten different observers, will be found of especial value.

On the Freezing Points of Dilute Aqueous Solutions: By E. H. LOOMIS. The phenomenon of the lowering of the freezing point of a liquid by the presence of a dissolved salt has so important a bearing upon the theory of solutions that innumerable experimenters have made it a subject of study. That such determinations are extremely liable to serious error is shown by the disagreement between the results of different observers. In some previous work on this subject Dr. Loomis was led to make several improvements in methods and apparatus. The present paper gives the results of his new methods in the case of certain electrolytes, the salts studied being principally chlorides, carbonates and nitrates. In general the results may be said to be in fair agreement with the theory of electrolytic dissociation. With KCl and K_2SO_4 the agreement is complete. With half a dozen other salts it is not so good, but fairly satisfactory. K_2CO_3 and Na_2CO_3 show considerable discrepancies, which, however, may be due to uncertainty in the determination of the conductivities of these salts.

Dr. Loomis devotes considerable time to a discussion of the probable accuracy of his results, and in a minor article in the same number of the *Review* answers certain objections which have been raised against his earlier determinations.

A Comparison of two Concave Rowland Gratings: By ALICE H. BRUÈRE. Miss Bruère subjects the well-known irregularities in the intensity of the different spectra from a concave grating to a careful photometric study. The results show the same general character as those reached by Paschen by bolometric methods. The curves which accompany Miss Bruère's article show in a most striking manner the irregularities in intensity in different parts of the same spectrum, as well as in the spectra of different orders.

A New Apparatus for the Study of Color Phenomena: By E. R. VON NARDROFF. Mr. von Nardroff describes an ingenious apparatus to be used with a lantern for conveniently showing the various experiments dealing with color mixing, contrast, complementary colors, etc. The apparatus has been used by Mr. von Nardroff for several years and found satisfactory and convenient.

On a New Form of Water Battery: By L. W. AUSTIN and C. B. THWING. The writers have devised a cell which is constructed out of a homeopathic vial and strips of sheet copper and zinc, and which appears to possess considerable advantages. The chief novelty consists in the form of the two electrodes. Ease of construction, convenience in filling, and permanence of action are the advantages urged.

Books Reviewed: Daniell, Principles of Physics; Whetham, Solution and Electrolysis; S. P. Thompson, Polyphaze Currents; Palaz, Industrial Photometry; Walter, Oberflächenfarben; Clerke, The Herschels and Modern Astronomy.

SOCIETIES AND ACADEMIES.

JOINT COMMISSION OF THE SCIENTIFIC SOCIETIES OF WASHINGTON.

THE memorial meeting held by the Scientific Societies of Washington, on Wednesday evening, January 14th, at which addresses were made in honor of Dana, Pasteur, von Helmholtz and Huxley, was followed on the following evening, the 15th, by a meeting of the Joint Commission, in honor of the late Charles V. Riley, the entomologist. The memorial address by